OH-58C Flight Test Plan

CORRELATION OF TRANSMISSION VIBRATION PATTERNS WITH FLIGHT REGIME STATES

Second Flight Series
Summer 2000

Research Aircraft OH-58C (Army 20724)

NASA Ames Research Center
Moffett Field, California

Andy Carter

Principal Program Manager, Sigpro

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CONTENTS

Special Note:

Sections 1 and 2 are primarily the work of the principal investigator, Dr. Ed Huff (NASA Ames Research Center), substantially reproduced here for convenience from the preceding work of reference 8. Some specifics are updated to reflect the differences between the Cobra and the Kiowa aircraft, and procedural improvements based on earlier experience.

1. INTRODUCTION

1.1 Purpose of Test

This test will acquire flight data which will be used to determine the extent to which basic maneuvers influence characteristic vibration patterns of the main rotor transmission. If the results indicate that flight maneuvers systematically influence vibration performance, then more extensive studies will be conducted to explore the full response surface. This test will also provide baseline time series data, collected under quasi-static flight conditions, that will be compared with similar time series data recorded from transmission test stands at Glenn Research Center.

The series of tests described in this Flight Test Plan closely parallel the series conducted using an AH-1 Cobra in Summer of 1998 (see reference 8.)

1.2 Overview

The OH-58C test helicopter, U.S. Army serial number 71-20724, will be flown OGE in 14 steady-state flight conditions. These will be replicated six times in quasi- random order over a course of several flights. Continuous recordings, of thirty seconds each, will be taken from up to six accelerometers, one rotor once-per-rev sensor, and an engine torque sensor.

The test aircraft is shown in figure 1. The 14 maneuvers will be flown at the Moffett Federal Airfield. A single research pilot will fly the aircraft from the right seat, and a test operator will operate the test gear from the left seat.

1.3 Background

For both safety and cost-reduction reasons, there is continuing interest in the rotorcraft community for monitoring fatigue damage in critical aircraft components [1-3]. The ability to identify faults near threshold, and to make accurate in-flight predictions, well in advance of component failure, is a key objective underlying the development of all health and usage monitoring systems (HUMS).

The distinction between health monitoring and usage monitoring is shown in Fig. 2 in terms of the assumed service life of aircraft components. There are two basic premises: (1) each component has a nominal predicted life, and (2) each component is subject to an nominal rate of usage. Taken together, these two provisions establish an in-service limit, or "time-between-overhaul" (TBO). *Predicted life* is the component health parameter, the nominal value of which is based on a hypothetical population of similar units. *Usage rate* is the life consumption parameter that models what the component loses from a typical mission for which the aircraft was designed

Figure 1: Research Aircraft, OH-58C

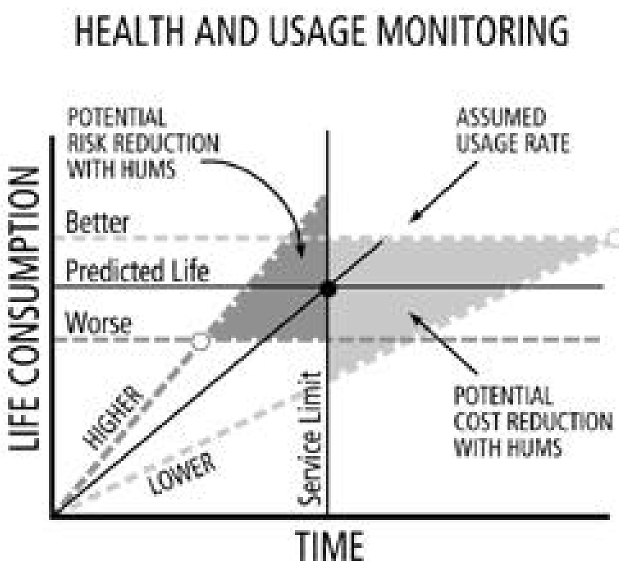


Figure 2: Risk and cost reduction prospects with HUMS.
Diagram adapted from Augustin *et al* [4].

The shortcomings of either assumption may be mitigated by basing operating decisions on measurements of the health and usage parameters. If the *usage rate* were higher or lower than nominally assumed, adjustments could be made to the TBO on a conditional basis to shorten or extend the service limit. If component *health* were measured with validity, which is the subject of this study, significant safety improvements and cost reductions could also be obtained. Indeed, as shown in the diagram, taken together the two measurements could expand the value of either considered separately.

The Problem of Health Prognosis

Although gross health parameter operating ranges (e.g., temperature, vibration energy, oil debris mass, etc.) can be established on a heuristic basis, simply flagging such parameter exceedances does not in itself address the fundamental problem of detecting subtle fatigue faults near threshold, diagnosing their origin, tracking them in real-time, or predicting their temporal trajectories. This more extensive form of health monitoring and reasoning, i.e., *prognostics*, is ultimately what is required to provide the long lead-times needed to anticipate failures. Such a capability might also open the door to actively prolonging component life through mission, flight regime, or maneuver limiting.

It is not prudent simply to generalize test stand results to the flight situation, because vehicle maneuvering may be expected to have complex, possibly non-linear effects on vibration patterns. Moreover, many sources of vibration are present in flight (e.g., engine, main rotor, tail rotor, A/C, etc.) which make the recorded time series much more challenging to analyze. Accordingly, it is necessary to record these effects in a flying laboratory such as FLITE

Research Plan

The complete research plan involves:

1. Flight Data Collection
2. Data Preparation
3. Feature Extraction
4. Analysis of Variance
5. Data Modeling
6. Pattern Classification

This flight test plan, however, is restricted to only to the first stage - *i.e.*, data collection. All subsequent activities will be done in the laboratory after the data are available.

1.4 Participants

1.4.1 Research Team

NASA Personnel:
Edward M. Huff, *Principal Scientist*

Sigpro Personnel:
Mark Dzwonczyk, *Principal Engineer*
Andy Carter, *Program Manager*
Larry Cochrane, *Senior Engineer*

1.4.2 Flight Experiment Team

Test Director:	tbd
Observer/Operator:	Scott Miller, Raytheon Aerospace Company
OH-58C Pilots:	George Tucker, Code ARH, NASA ARC
Ground Support Engineer:	Larry Cochrane (Sigpro)

2. TEST MANEUVERS

2.1 Description of Maneuvers

For purposes of analysis it will be desirable to assume that time-series recordings are taken during stationary (statistically stable) periods of flight. The underlying process is treated as stationary even though it is clearly not. This is similar to piecewise linearization and allows procedures such as synchronous averaging to eliminate Gaussian noise. To eliminate random noise, and to isolate component signatures, it may also be desirable to use synchronous time-averaging techniques on the data. Hence, this particular test will collect prolonged samples (i.e., 30 sec.) and avoid recording activity during transient periods of maneuvering.

The flight experiment corresponds to a one-way analysis of variance (ANOVA) with treatments defined as 14 basic flight maneuvers. During the experiment each treatment will be replicated r = 6 except for conditions G and H where r = 8 times.

The 14 maneuvers are listed in the following table. Details about each maneuver are provided in the text below.

Maneuver	Name	Symbol	Description
A	Forward Flight, Low Speed	FFLS	Fly straight, level, & forward at ~ 20 kt
B	Forward Flight, High Speed	FFHS	Fly straight, level, & forward at ~ 60 kt
C	Sideward Flight Left	SL	Fly straight, level, & sideward left
D	Sideward Flight Right	SR	Fly straight, level, & sideward right
E	Forward Climb, Low Power	FCLP	Fly forward, straight, & climbing at xx psi [XX % torque] – 80 kt
F	Forward Descent, Low Power	FDLP	Fly forward, straight, & descending at yy psi [YY % torque] – 80 kt
G	Flat Pitch on Ground	G	Vehicle on ground skids
H	Hover	H	Stationary hover
I	Hover Turn Left	HTL	Level hover, turning left
J	Hover Turn Right	HTR	Level hover, turning right
K	Coordinated Turn Left	CTL	Fly level, forward, & turning left – 60 kt
L	Coordinated Turn Right	CTR	Fly level, forward, & turning right – 60 kt
M	Forward Climb, High Power	FCHP	Fly forward, straight, & climbing at zz psi [ZZ % torque] – 80 kt
N	Forward Descent, High Power	FDHP	Fly forward, straight, & descendingat zz psi [ZZ % torque] – 80

Figure 3: List of Maneuvers

This experiment is set up for the following boundary conditions:

Fixed (controlled) Conditions

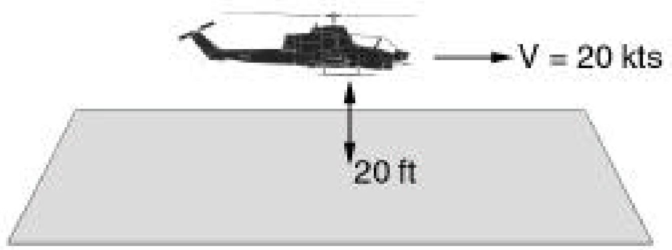
- Altitude AGL
- Air Speed
- Aircraft Weight
- Engine Torque

Variable (uncontrolled) Conditions

- Winds
- Ambient Temperature
- Fuel Level

2.1.A Forward Flight, Low Speed (FFLS) Maneuver

The aircraft shall fly straight, coordinated level for 34 seconds at a constant airspeed above transitional lift (approximately 20 kt).

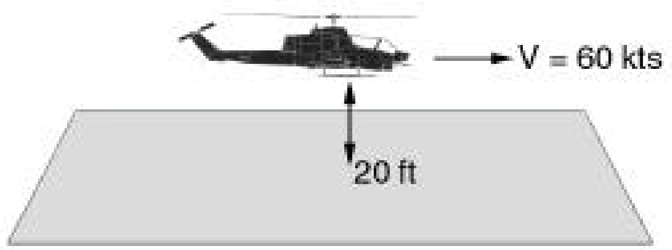


Altitude: 20 ft ± 5 ft

Velocity: Above transitional lift, approx. 20 kt

2.1.B Forward Flight, High Speed (FFHS) Maneuver

The aircraft shall fly straight, coordinated level for 34 seconds at 60 kt.

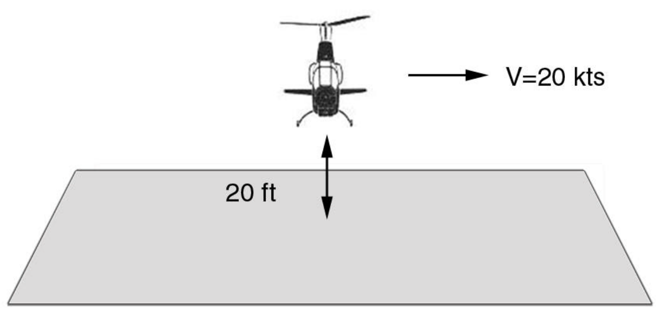


Altitude: 20 ft ± 5 ft

Velocity: 60 kt target

2.1.C Sideward Flight Left (SL) Maneuver

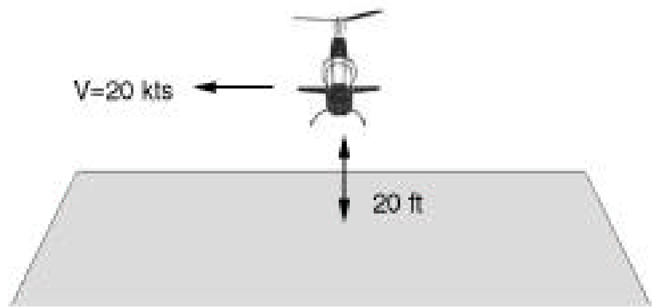
The aircraft shall fly sideward left at a constant airspeed above transitional lift (approx. 20 kt) for 34 seconds.



Altitude: 20 ft ± 5 ft

Velocity: Above transitional lift, approx. 20 kt

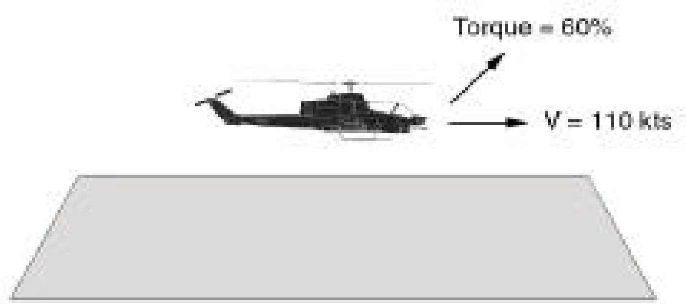
2.1.D Sideward Flight Right (SR) Maneuver
The aircraft shall fly sideward right at a constant airspeed above transitional lift (approx. 20 kt) for 34 seconds.



Altitude: 20 ft ± 5 ft

Velocity: Above transitional lift, approx. 20 kt

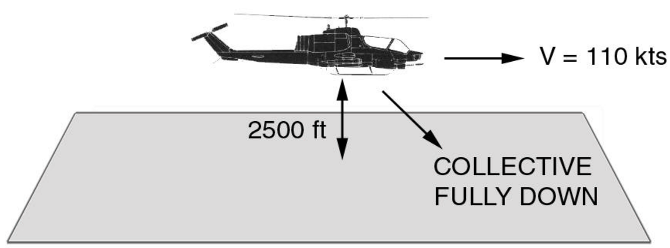
2.1.E Forward Climb, Low Power (FCLP) Maneuver
The aircraft shall climb at 80 kt and 60% torque for 34 seconds.



Velocity: 110 kt

Torque: 60%

2.1.F Forward Descent, Flat Pitch (FDFP) Maneuver
The aircraft shall descend at 80 kt, collective fully down, for 34 seconds, starting at an altitude of 2500 feet and 2.5 nautical miles from Moffett Field.

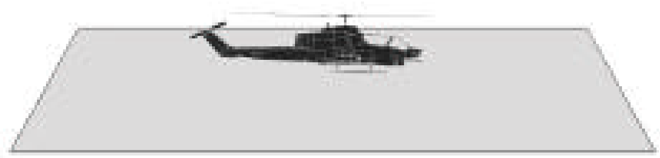


Velocity: 110 kt

Start Altitude: 2500 feet

Start Position: 2.5 naut. miles from Moffett

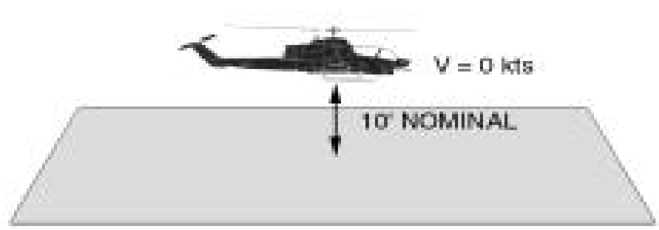
2.1.G Flat Pitch on Ground (G) Maneuver
The aircraft will reside on the ground at flat pitch with collective fully down for 34 seconds.



Altitude: 0 feet

Velocity: 0 kt

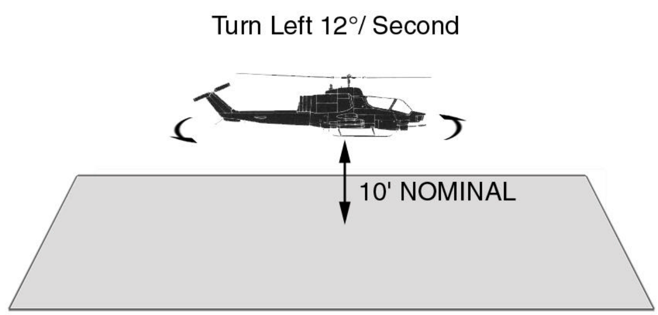
2.1.H Hover (H) Maneuver
The aircraft will maintain a stable and smooth hover for 34 seconds.



Altitude: 10 feet nominal

Velocity: 0 kt

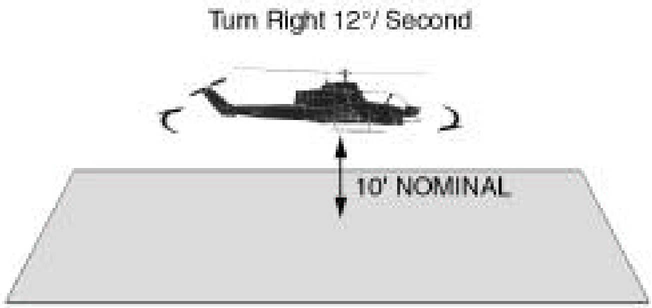
2.1.I Hover Turn Left (HTL) Maneuver
The aircraft shall perform a left hovering turn at 12 degrees per second for 34 seconds. (One full turn in approximately 30 seconds.)



Altitude: 10 feet nominal

Wind Conditions: < 5 kt

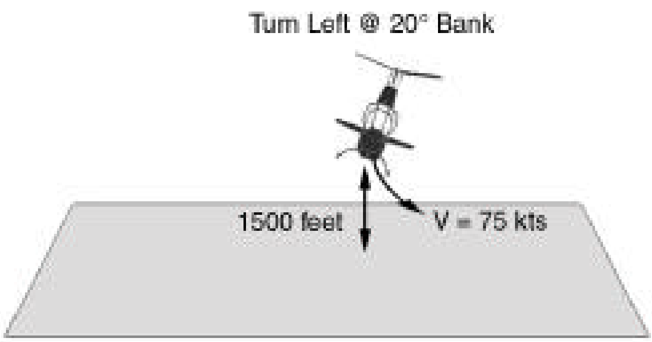
2.1.J Hover Turn Right (HTR) Maneuver
The aircraft shall perform a right hovering turn at 12 degrees per second for 34 seconds. (One full turn in approximately 30 seconds.)



Altitude: 10 feet nominal

Wind Conditions: < 5 kt

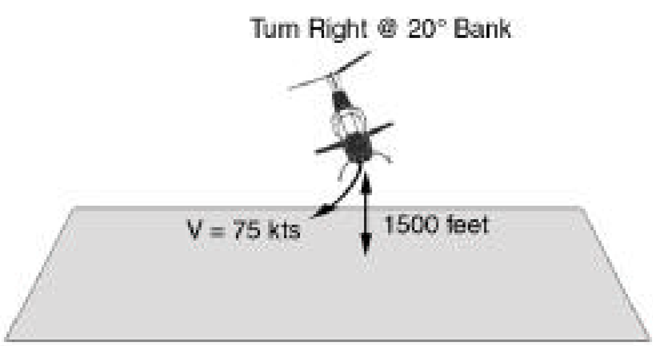
2.1.K Coordinated Turn Left (CTL) Maneuver
The aircraft shall perform a 20° bank turn left at 75 kt for 34 seconds.



Altitude: 1500 ft

Velocity: 75 kt target

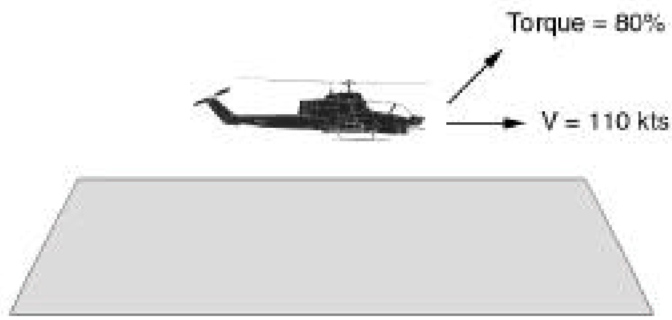
2.1.L Coordinated Turn Right (CTR) Maneuver
The aircraft shall perform a 20° bank turn right at 60 kt for 34 seconds.



Altitude: 1500 ft

Velocity: 60 kt target

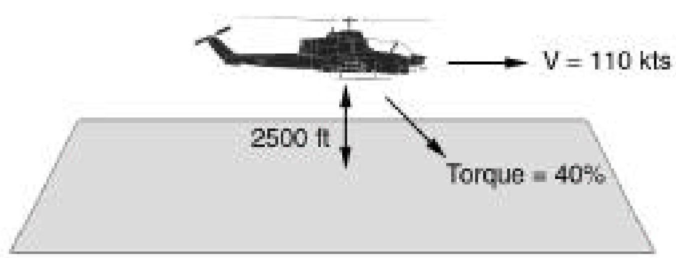
2.1.M Forward Climb, High Power (FCHP) Maneuver
The aircraft shall climb at 80 kt and 80% torque for 34 seconds.



Velocity: 80 kt target

Torque: 80%

2.1.N Forward Descent, High Power (FDHP) Maneuver
In this maneuver, the aircraft shall descend at 80 kt and 40% torque for 34 seconds, starting at an altitude of 2500 feet and 2.5 nautical miles from Moffett Field.



Velocity: 80 kt target

Torque: 40 %

Start Altitude: 2500 feet

Start Position: 2.5 naut. miles from Moffett

2.2 Maneuver Execution Order

The full experiment E = {m, r} is comprised of m = 14 basic maneuvers (i.e., "treatments") repeated r = 6 except for conditions G and H where r = 8 times (i.e., "replications"). A continuous 30 seccond recording will be made for each of these conditions.

It is estimated that approximately 2 minutes and 30 seconds of flight time will be required to position the aircraft for each maneuver. It is estimated that approximately 1 minutes and 30 seconds of flight time will be required to obtain and store data from each maneuver: 30 seconds of data recording; 1 minute for downloading to disk media. The aggregate flight time for each maneuver, thus, is estimated to be 4 minutes. This means that 25 or more sequences of maneuvers could be completed in approximately two hours.

To accommodate all conditions, data recording is spread out over several flights. At the beginning and end of each flight, the Stationary Vehicle tests (G, *Flat Pitch on Ground*, and H, *Hover*) will be executed. This will give the flight a set of reliable references to help understand the uncontrolled variables.

During each flight, the order of the straight flight and turning flight maneuvers will be controlled by a simple “Latin square” design as shown below. This is used to counterbalance possible confounding effects, such as the uncontrolled conditions indicated above.

Important Note:

Since each maneuver appears once in each row and column of the Latin square matrix, this procedure assures that average fuel level (and hence vehicle gross weight) is reasonably balanced over six replications. It also provides some assurance that time related factors (e.g., ambient temperature) are reasonably matched due to changes in sun position, density altitude, etc.

Note that the procedure does not control for binary maneuver sequence effects, (e.g., 2 always follows 1, 3 always follows 2, etc.). This is not felt to be an imporant consideration, however, because a large amount of time intervenes between successive maneuvers.

The scheduled experiments maneuvers for each of the four flights are tabulated below.

2.2.1 Flight One

Replication	Maneuver					
1	G	H				
1	A	B	C	D	E	F
2	B	C	D	E	F	A
3	C	D	E	F	A	B
2	H	G				

That is, the sequence of 22 tests for Flight One will be as follows:

1 Flat Pitch 0n Ground (G) Repetition 1
2 Hover (H) Repetition 1
3 Forward Flight, Low Speed (A) Repetition 1
4 Forward Flight, High Speed (B) Repetition 1
5 Sideward Flight Left (C) Repetition 1
6 Sideward Flight Right (D) Repetition 1
7 Forward Climb, Low Power (E) Repetition 1
8 Forward Descent Low Power (F) Repetition 1
9 Forward Flight, High Speed (B) Repetition 2
10 Sideward Flight Left (C) Repetition 2
11 Sideward Flight Right (D) Repetition 2
12 Forward Climb, Low Power (E) Repetition 2
13 Forward Descent Low Power (F) Repetition 2
14 Forward Flight, Low Speed (A) Repetition 2
15 Sideward Flight Left (C) Repetition 3
16 Sideward Flight Right (D) Repetition 3
17 Forward Climb, Low Power (E) Repetition 3
18 Forward Descent Low Power (F) Repetition 3
19 Forward Flight, Low Speed (A) Repetition 3
20 Forward Flight, High Speed (B) Repetition 3
21 Hover (H) Repetition 2
22 Flat Pitch 0n Ground (G) Repetition 2

2.2.2 Flight Two

Replication	Maneuver					
3	G	H				
1	I	J	K	L	M	N
2	J	K	L	M	N	I
3	K	L	M	N	I	J
4	H	G				

That is, the sequence of 22 tests for Flight Two will be as follows:

1 Flat Pitch 0n Ground (G) Repetition 3
2 Hover (H) Repetition 3
3 Hover Turn Left (I) Repetition 1
4 Hover Turn Right (J) Repetition 1
5 Coordinate Turn Left (K) Repetition 1
6 Coordinate Turn Right (L) Repetition 1
7 Forward Climb, High Power (M) Repetition 1
8 Forward Descent, High Power (N) Repetition 1
9 Hover Turn Right (J) Repetition 2
10 Coordinate Turn Left (K) Repetition 2
11 Coordinate Turn Right (L) Repetition 2
12 Forward Climb, High Power (M) Repetition 2
13 Forward Descent, High Power (N) Repetition 2
14 Hover Turn Left (I) Repetition 2
15 Coordinate Turn Left (K) Repetition 3
16 Coordinate Turn Right (L) Repetition 3
17 Forward Climb, High Power (M) Repetition 3
18 Forward Descent, High Power (N) Repetition 3
19 Hover Turn Left (I) Repetition 3
20 Hover Turn Right (J) Repetition 3
21 Hover (H) Repetition 4
22 Flat Pitch 0n Ground (G) Repetition 4

2.2.3 Flight Three

Replication	Maneuver					
5	G	H				
4	D	E	F	A	B	C
5	E	F	A	B	C	D
6	F	A	B	C	D	E
6	H	G				

That is, the sequence of 22 tests for Flight Three will be as follows:

1 Flat Pitch 0n Ground (G) Repetition 5
2 Hover (H) Repetition 5
3 Sideward Flight Right (D) Repetition 4
4 Forward Climb, Low Power (E) Repetition 4
5 Forward Descent Low Power (F) Repetition 4
6 Forward Flight, Low Speed (A) Repetition 4
7 Forward Flight, High Speed (B) Repetition 4
8 Sideward Flight Left (C) Repetition 4
9 Forward Climb, Low Power (E) Repetition 5
10 Forward Descent Low Power (F) Repetition 5
11 Forward Flight, Low Speed (A) Repetition 5
12 Forward Flight, High Speed (B) Repetition 5
13 Sideward Flight Left (C) Repetition 5
14 Sideward Flight Right (D) Repetition 5
15 Forward Descent, Low Power (F) Repetition 6
16 Forward Flight, Low Speed (A) Repetition 6
17 Forward Flight, High Speed (B) Repetition 6
18 Sideward Flight Left (C) Repetition 6
19 Sideward Flight Right (D) Repetition 6
20 Forward Climb, Low Power (E) Repetition 6
21 Hover (H) Repetition 6
22 Flat Pitch 0n Ground (G) Repetition 6

2.2.4 Flight Four

Replication	Maneuver					
7	G	H				
4	L	M	N	I	J	K
5	M	N	I	J	K	L
6	N	I	J	K	L	M
8	H	G				

That is, the sequence of 22 tests for Flight Four will be as follows:

1 Flat Pitch 0n Ground (G) Repetition 7
2 Hover (H) Repetition 7
3 Coordinate Turn Right (L) Repetition 4
4 Forward Climb, High Power (M) Repetition 4
5 Forward Descent, High Power (N) Repetition 4
6 Hover Turn Left (I) Repetition 4
7 Hover Turn Right (J) Repetition 4
8 Coordinate Turn Left (K) Repetition 4
9 Forward Climb, High Power (M) Repetition 5
10 Forward Descent, High Power (N) Repetition 5
11 Hover Turn Left (I) Repetition 5
12 Hover Turn Right (J) Repetition 5
13 Coordinate Turn Left (K) Repetition 5
14 Coordinate Turn Right (L) Repetition 5
15 Forward Descent, High Power (N) Repetition 6
16 Hover Turn Left (I) Repetition 6
17 Hover Turn Right (J) Repetition 6
18 Coordinate Turn Left (K) Repetition 6
19 Coordinate Turn Right (L) Repetition 6
20 Forward Climb, High Power (M) Repetition 6
21 Hover (H) Repetition 8
22 Flat Pitch 0n Ground (G) Repetition 8

3. OVERALL TEST CONDITIONS & RESTRICTIONS

3.1 Wind

Wind velocity shall be less than 10 kt, except for Maneuvers I and J (Hover turns) in which wind velocity shall be less than 5 kt

3.2 Altitude

The flight tests must be executed at an altitude not less than 10 feet

3.3 Ambient Air Temperature

Ground level temperature shall be above 45° F

3.4 Turbulence

Turbulence shall be nil to light

3.5 Fuel Level

Each test flight will be initiated at the maximum fuel level permitted within the weight and balance limitations specified by the current revision of the Operator's Manual for the OH-58C helicopter (U.S. Army TM 55-1520-228-10). The flight tests will be terminated once the fuel level reaches 100 lb

3.6 Airfield Clearance

The Moffet Field runway shall be clear of other aircraft in accordance with applicable air traffic control procedures.

4. TEST SETUP

4.1 Aircraft Modifications

A schematic of the aircraft and installation points for special equipment is depicted in Figure 4 below.

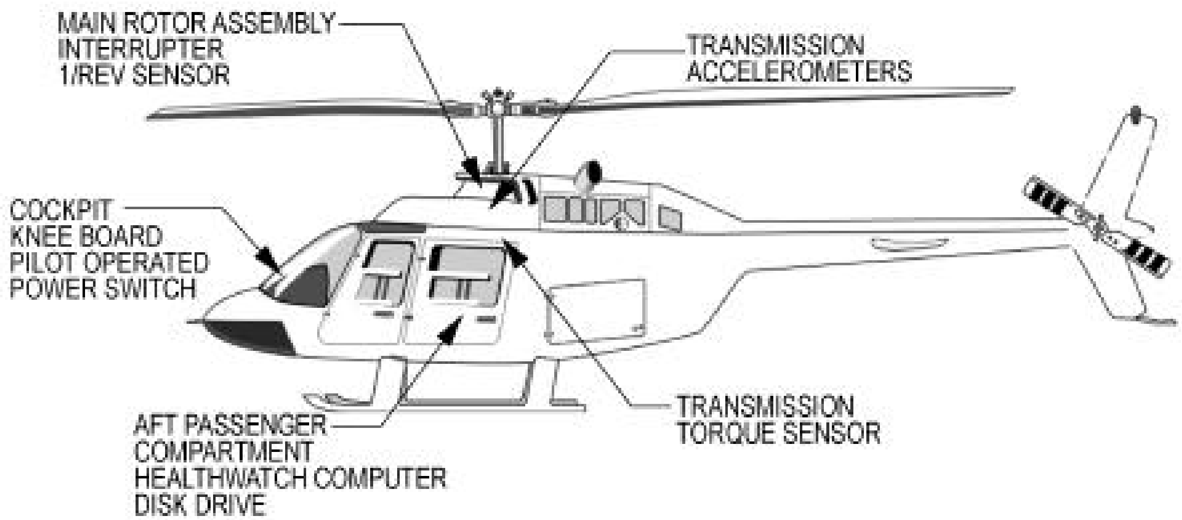


Figure 4 Aircraft Installations

The health and usage monitoring system (HUMS) consists of a specialized data acquisition computer and supporting electronics. The supporting electronics unique to this flight experiment include between one and six (nominally, two) accelerometers mounted to the lower bolt ring of the main transmission case, and a tachometer consisting of a once-per-revolution signal encoder from an interrupter located on the main rotor shaft. Also, an oil pressure sensor is installed to acquire rotor-shaft torque measurements.

The accelerometers are Endevco model 7529A-10 (single-axis) and are mounted to the existing transmission case bolt ends using a special fitting described in Drawing A7724-0001-M400.

The oil pressure sensor, a CEC-5000, installed on the torque oil line above the right-seat passenger, is the primary transducer for measuring main rotor torque.

The data acquisition computer, called "HealthWatch," was designed by California Signal Processing Associates, Inc. (“Sigpro”) of Los Altos, California. HealthWatch is a ruggedized IBM PC-compatible computer. The computer and its associated equipment will be mounted in the aft passenger compartment on a special pallet, illustrated in Drawing A7724-0001-M100, shown for reference in Appendix A.

All installed masses meet the design load requirements specified for the OH-58C test vehicle, as determined by project structural analysis, document number A7724-0001-XD1, “Health and Usage Monitoring System OH-58 Kiowa Installation Stress Analysis”.

Aircraft rewiring for this equipment is minimal. All power for the HUMS equipment is supplied through a circuit breaker originally used for an armament subsystem, accessible to the pilot. In case of failure, the pilot can cut off power to the research equipment, and thus electrically isolate it from other systems on the aircraft.

The HealthWatch is powered by a dedicated circuit (previously used to power mission equipment) protected with a circuit breaker. The electrical load of the HealtWatch equipment is well within the capacity of the power available, as determined by project electrical analysis. Ref: (Leonard H report #)

4.2 Equipment for Test Director, Operator and Pilot

The Test Director does not interact with the mission operation in progress, unless the pilot or operator initiate radio contact for the purpose of special remarks or inquiry. Therefore no special equipment is required, other than presence at mission control base radio.

The Observer/ Keypad Operator (“Operator”) uses the lap top/kneeboard terminal, as shown in Appendix A.

The Pilot’s Checklist will reflect the addition of the research equipment, including the identification of the switch used to energize or de-energize the research equipment. The pilot has access to the circuit breaker to the research equipment, which is part of the normal cockpit breaker panel of the OH-58C. No other special equipment is required.

4.3 Preflight Procedures

Before the first flight, an EMC (electromagnetic compatibilty) test will be conducted, with all of the research equipment mounted and energized, to assure that there are no adverse interactions with the flight control systems.

Before the first flight, the torque sensor will undergo a ground check (engine running) to correlate tranmission oil pressure to torque, such that a conversion factor can be determined for subsequent data-reduction computations, and to verify that the torque sensor does not affect the performance of the host aircraft’s torque indicator.

The HealthWatch system will be preflight checked for normal operation within 24 hours of each data collection flight. The battery shall be changed on the lap-top terminal before each flight. A sticker on the bottom of the unit will indicate the last date the battery was changed. The interrupter and interrupter sensor will be checked for mechanical integrity before the first flight of each flight date. The clearance between the interrupter and the interrupter sensor will be checked before each flight, whether or not data will be collected.

Pre-flight briefings will be conducted in accordance with Flight Projects Office procedures. The Observer/ Keypad Operator will be trained and qualified to perform the required test duties, and will be briefed on safety and communications procedures prior to flight.

5. DATA COLLECTION

Three types of data will be collected during each flight:

1. Computer-acquired signals at HealthWatch
2. Subjective Operator and Pilot comments
3. Flight Test Log

5.1 Computer-Acquired Signals at HealthWatch

For each experiment test, HeathWatch will automatically acquire and store the predetermined set of signals from the accelerometers, rotor revolution sensor, and torque sensor. The signal acquisition will occur in real-time for approximately 30 seconds. Data storage of the acquired signals will be performed after the acquisition phase and will take less than one minute. Further data acquisition is precluded during this storage period. The system reports to the laptop terminal when the storage activity is complete and a new test can be started. The data storage phase will also included error checking on the removable media storage disk.

5.2 Subjective Pilot Comments

At the completion of each test, the Pilot and Operator will relay subjective comments on the quality of the test, including aircraft performance and environmental conditions. These comments will be manually transcribed into the flight log.

5.3 Flight Test Log

The Test Director will maintain a flight test log for the entire duration of the flight. This includes tabulating necessary data on each experiment. A sample Flight Test Log is depicted in Appendix B. The log will include pre-flight and post-flight fuel status and any other factors influencing aircraft gross flight weight, that might be necessary for subsequent data interpretation.

This log will be transcribed by the Ground Support Engineer into an electronic database maintained in a project computer.

6. OPERATIONS

For each of the flight tests, and after Preflight Procedures are completed, the sequence of 14 flight maneuvers will be executed, and the test data recorded. The fiure 6 flow chart depicts the process for executing each of the 14 tests. Refer to the Important Note in Section 2.2 regarding the reasons for the order of flight maneuvers. In summary, each test will be executed and data will be recorded. Data will be stored for all tests, even those that were rejected, and subsequently repeated.

Based on prior Cobra FLITE experience, one loop through the flow chart is expected to take less than 3 minutes, so that the 14 flight tests should take no longer than one hour. Therefore the entire sequence of tests should be completed within 8 flight hours.

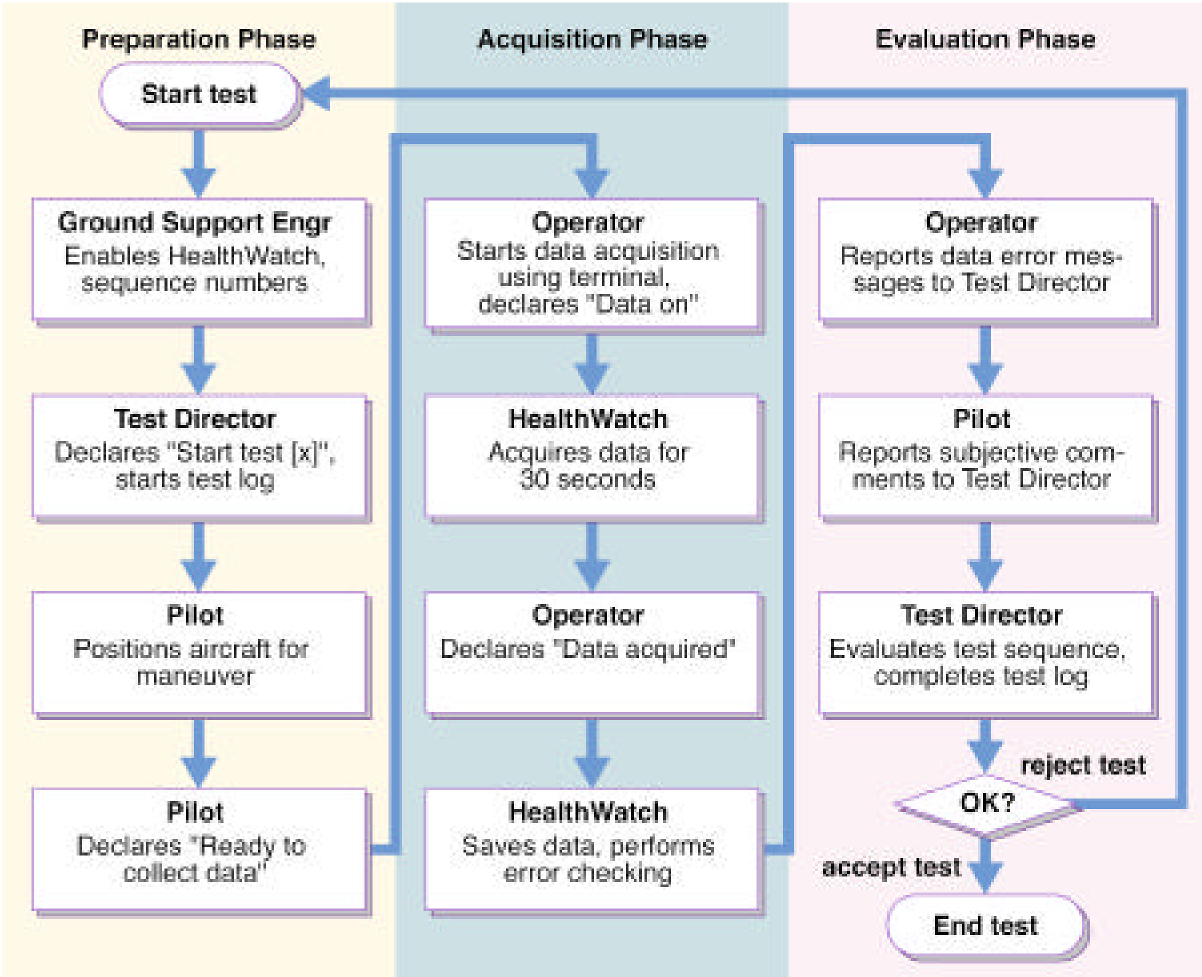


Figure 6: Test Sequence Flow Chart

7. RISK ANALYSIS

The completion of the subject test series in a safe manner is given the highest priority in this activity.

7.1 Risk Identification and Assessment Methodology

Each operation required by this test plan was examined to determine potential hazards. An assessment of the severity of the risk, based on the probability of occurrence and the potential result of the event, utilized the U.S. Army risk assessment chart shown in figure 7.

HAZARD SEVERITY		HAZARD PROBABILITY				
		FREQUENT Likely to Occur Frequently During The Test	**PROBABLE** Will Occur Several Times During the Test	**OCCASIONAL** Likely to Occur Sometime During the Test	**REMOTE** Unlikely but Possible to Occur During the Test	**IMPROBABLE** So Unlikely It Is Assumed Occurrence May Not Be Experienced
		A	**B**	**C**	**D**	**E**
CATASTRO-PHIC Death or System Loss	I	**High**	**High**	**High**	**High**	**Medium**
CRITICAL Severe Injury or Major System Damage	II	**High**	**High**	**High**	**Medium**	**Low**
MARGINAL Minor Injury or Minor System Damage	III	**High**	**Medium**	**Medium**	**Low**	**Low**
NEGLIGIBLE Less Than Minor Injury or System Damage	IV	**Medium**	**Medium**	**Low**	**Low**	**Low**

Figure 7. US Army risk assessment chart.

7.2 Risks and Risk Mitigation

[to be added]

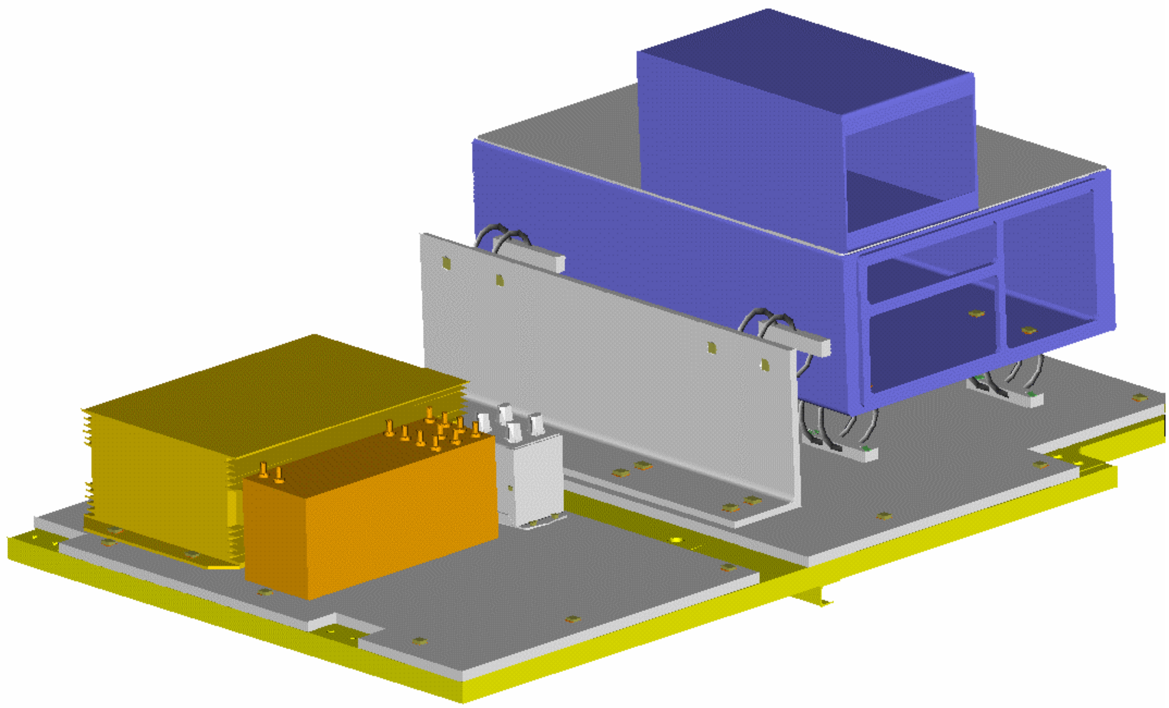
Appendix A – Aircraft Modifications

A – 1 Kneeboard/Lap Top Control Terminal

Location: Left-seat Operator's station

Description: The terminal is used by the Operator to monitor and control the software in the HealthWatch computer system. This display is an LCD with 4 lines of text. The unit plugs into the Lap Top Switch Panel, mounted on the equipment pallet in the rear passenger compartment. This unit requires a 9-volt battery to operate.

A – 2 HUMS Equipment Pallet



Location: Aft passenger compartment

Description: Refer to Drawing A7724-0001-M100 (the above illustration is provided for reference only). The pallet provides a ruggedized mounting, including vibration isolation, for the HealthWatch computer, its Jaz data storage unit, and associated power and signal conditioning units. Instrumentation sensors located at points of interest on the machinery are terminated at this equipment. The cockpit Operator's Kneeboard Lap Top Control Terminal unit is connected here, as well.

Appendix B – Sample Flight Test Log

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Approvals

This Flight Test Plan has been reviewed and approved by:

Edward M. Huff, PhD — Date
Principal Scientist, Computational Sciences Division

Barry Lakinsmith, — Date
Chief, Flight Control & Cockpit Integration Branch

MAJ David Arterburn, — Date
Chief, Flight Projects Office